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MANAGERIAL DECISIONS IN LOGISTIC SYSTEMS OF MILK PROVISION ON VARIABLE PRODUCTION CONDITIONS

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ABSTRACT

The study of the influence of variable production conditions and the work in logistics milk harvesting systems on the value indicators of their functioning has been carried out. A method that enables to solve the task of coordinating the content of work with variable production conditions is proposed. It has been established that there are seven variants of the content of work in logistics milk harvesting systems, each of which has its own specifics. Computer experiments were carried out using the developed simulation model of logistics processes implementation. On the example of the production conditions of the Brody district in the Lviv region, trends in changing the cost performance of logistics operations for various content during the year are established.

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On the basis of the defined cost indicators, specific costs of funds for the execution of logistic works for each of the variants of their content are determined. It is substantiated that effective performance of work in logistic systems of milk harvest requires operational planning of their content for each of the days of milk harvest season. The conducted studies will be useful for managers who perform operational planning in logistics milk harvesting systems.

Keywords: managerial decisions; operational planning; logistics systems; milk harvesting; content of works

1. INTRODUCTION

Nowadays there still is a problem of providing people with quality food products. At the same time a complete diet is impossible without dairy products. However, dairy products are perishable foods and their quality is regulated by EU standards (ZUBA-CISZEWSKA, 2018; STANDART ISO9000). The quality of dairy production depends both on technology and technical equipment, and on the efficiency of the work in the chain of production-harvesting-processing of milk-raw materials.

For the efficient functioning of logistic milk harvesting systems (LMHS), tasks related to harmonizing the content of work with variable production conditions should be solved daily. This task is related to the operational planning of the content and timing of the work in the LMHS. It needs a toolkit for planning that takes into account the features of these systems. One of the main features of this is that the effectiveness and timing of work are largely determined by both their changing production conditions and their content.

In addition, the toolkit for the operational planning of the content and timing of work implementation in the LMHS should take into account the characteristics of production conditions, such as the daily volume of milk harvested during the calendar year, and the characteristics of the road network that are specific to each administrative area.

There are the scientific papers on operational planning of works in various sectors of the national economy (HOFSTRA et al., 2019; SKARŻYŃSKA; ABRAMCZUK, 2017; PAREDES-BELMAR et al, 2016; BENDOLY et al, 2010; BUIJS et al., 2016). They substantiated the expediency of systematic decision-making in the presence of a set of objects (milk provision points (Pps)), which is typical for LMHS.

It is proved in scientific papers (PAREDES-BELMAR, 2016; BENDOLY et al., 2010; BUIJS et al., 2016) that the content of LMHS works for a set of software should be substantiated systematically from a single center (milk processing enterprise (MPE)).

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However, none of these scientific works reflects the peculiarities of milk production on the territory of the administrative district.

Scientific works (MWANGI; KARIUKI, 2015; BUIJS; WORTMANN, 2014); RIZOJEVA-SILAVA; ZEVERTE-RIVZA; PILVERE, 2018; BASHYNSKY, 2019) relate to the planning of works in various applied fields. In particular, these works prove that it is impossible to effectively plan any work without using approaches, methods and models that take into account peculiarities of the subject area. You should also develop application software to accelerate and improve the quality of management decisions. Also in the above-mentioned scientific works such instrumental means are offered. However, it is impossible to use them for planning works in LMHS as they do not take into account changing production conditions, as well as their influence on the content of work.

In scientific papers (LIOTTA; STECCA; KAIHARA, 2015; PETRAŠKA; ČIŽIŪNIENĖ; PRENTKOVSKIS; JARAŠŪNIENĖ, 2018; MICHA et al, 2017) it is proposed to determine the indicators of the use of vehicles based on the simulation of transport processes. However, it is impossible to use them to reconcile the content of works in LMHS with variable production conditions. In particular, they do not take into account the volatile daily volumes of milk harvesting during the calendar year, the peculiarities of the administrative territory and possible variants of the content of the logistics operations.

Scientific papers (QUINLAN, et al. 2012; TRYHUBA et al. 2019; RATUSHNY et al., 2019) relate to the planning of the content and time of execution of works and they take into account the production conditions on the basis of simulation process. However, the proposed toolkit does not take into account the features of the production conditions of LMHS, as well as the seasonality of milk harvesting. This significantly influences the effectiveness of logistics planning for milk harvesting (TRYHUBA et al., 2018; TRYHUBA et al., 2019).

The algorithm for matching the content and timing of work implementation in logistics systems for milk production with production conditions was developed in a scientific paper (TRYHUBA et al., 2019). However, it is based on average values of the duration of logistics operations, which does not fully reflect the real conditions. In addition, this work does not take into account the state of the road network between the software and the MPE, which does not allow qualitative and accurate research into the impact of the content and timing of the work on LMHS on their cost, taking into account the changing production conditions.

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The basis for effective planning of the LMHS's operation is the prognosis of variable production conditions, as well as the reflection of the performance of their work on the basis of simulation (TRYHUBA; BOYARCHUK; TRYHUBA; BOYARCHUK; FTOMA, 2019)). However, some administrative territories require the creation of specific LMHS, for which relevant studies should be carried out (RATUSHNY et al., 2019).

To solve the task of harmonizing the content of work with variable production conditions, we can use specific methods, algorithm and computer program, which will ensure the study of the impact of changing production conditions and the content of these works. In addition, it will provide a definition of specific deductible expenditures for work on certain days of the milk harvest season, which underlies the effective planning of the LMHS operation.

Given the fact that individual LMHS have specific production conditions for milk procurement, there is a need to investigate the impact of the content and lead time of the LMHS on their cost. It is necessary to take into account the changing production conditions, as well as the components of the execution time of logistics operations, which are conditioned by the condition of the road network.

At the same time, qualitative alignment of the content and time of work implementation if the LMHS with changing production conditions requires the development of an appropriate method based on simulation modelling of logistics operations.

The purpose of the work is to develop a method and study the impact of the content and time of work implementation at LMHS on their cost taking into account the changing production conditions.

2. THEORETICAL BACKGROUND

In the given LMHS works are carried out every day, these works include: 1) the reception and primary processing of milk (cooling) in the PP; 2) loading of vehicles in the PP; 3) milk transportation to MPE; 4) unloading of vehicles in MPE. The effectiveness of these works in LMHS depends on their content during a particular period. At the same time, their content is determined by the daily amount of milk provision on the territory of the given LMHS.

The amount of milk provision from individual milk farms can vary during the year (TRYHUBA et al., 2018). To solve the task of coordinating the content of work with variable production conditions of the given LMHS we developed a methodology, the algorithm of which involves the following steps: 1) the formation of a database on the production conditions of LMHS; 2) forecasting the daily amount of milk provision from individual farms during the

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year; 3) simulation of the work to determine their functional indicators; 4) valuation of individual variants of the content of the work; 5) determining the effective version of the content of the work (TRYHUBA; ZACHKO; GRABOVETS et al., 2018).

We developed a method of harmonization of the content of work with changing production conditions of specified in the LMHS with the changing production conditions, which involves five steps (Figure 1), in order to solve the problem of harmonizing the content of works with the variable production conditions of a given LMHS.

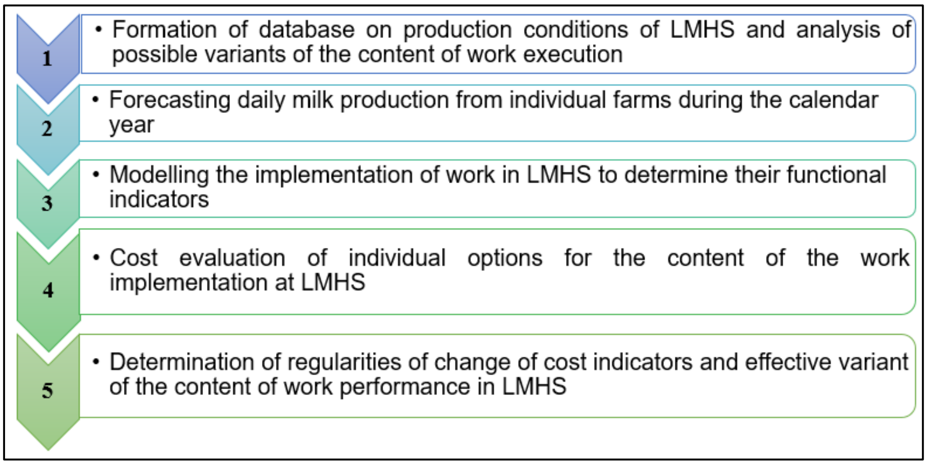

Figure 1: Stages of the method of reconciling the content and lead time of work implementation in LMHS with changing production conditions

Step 1. Formation of a database on production conditions of LMHS and analysis of possible variants of the content of work execution. The formation of the database on the production conditions of milk products involves studying the requirements of current standards for milk provision, justification of the characteristics of the climatic conditions in the milk harvesting zone, forecasting of demand and value for dairy products. Additionally, the presence of milk farms and their territorial location in relation to the Pp in the given LMHS is established, and the characteristics and the state of the network of roads between milk farms and PPs are explored.

Information on the presence and territorial location of milk farms that supply raw milk in the Pp is taken from the MPE reporting documentation (TRYHUBA et al., 2018). Information on the amount of raw milk from each farm in the separate day of the calendar year for which work is coordinated is taken from milk producers. The received information on the amount of raw milk harvesting is transmitted to MPE, where the coordination of works during operational planning through the telecommunication network is carried out.

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tep 2. Forecasting daily volume of of milk procurement from individual farms throughout the calendar year. Information on the availability and territorial location of PPs from which raw milk is supplied to the MPE is taken from the MPE reporting documentation (TRYHUBA et al., 2018).

Information on the volume of raw milk procurement from each of the PPs in a separate day of the calendar year, for which procurement and transport work is agreed, is obtained from milk producers. The obtained information on the volume of raw milk procurement is transmitted to the MPE, where the work is coordinated during the operational planning through the telecommunication network.

The peculiarity of forecasting the volume $\left(Q_{\partial i}\right)$ of milk production in a single day is that it is variable and depends on the period of harvest (lasting 365 days) throughout the calendar year. However, the bulk of milk production falls during the summer months, during which vehicles are heavily used for transport and procurement work (Figure 2).

The total volume $\left(Q_{\partial}^{k}\right)$ of milk procurement in the *j*-th day is:

$$Q_{\partial}^{k}=\sum_{j=1}^{n} Q_{\partial j}^{k}\cdot z_{j}\cdot k, \qquad (1)$$

where z_j – number of dairy cows per day; k – coefficient that takes into account the proportion of raw milk that the dairy farm leaves for its own needs.

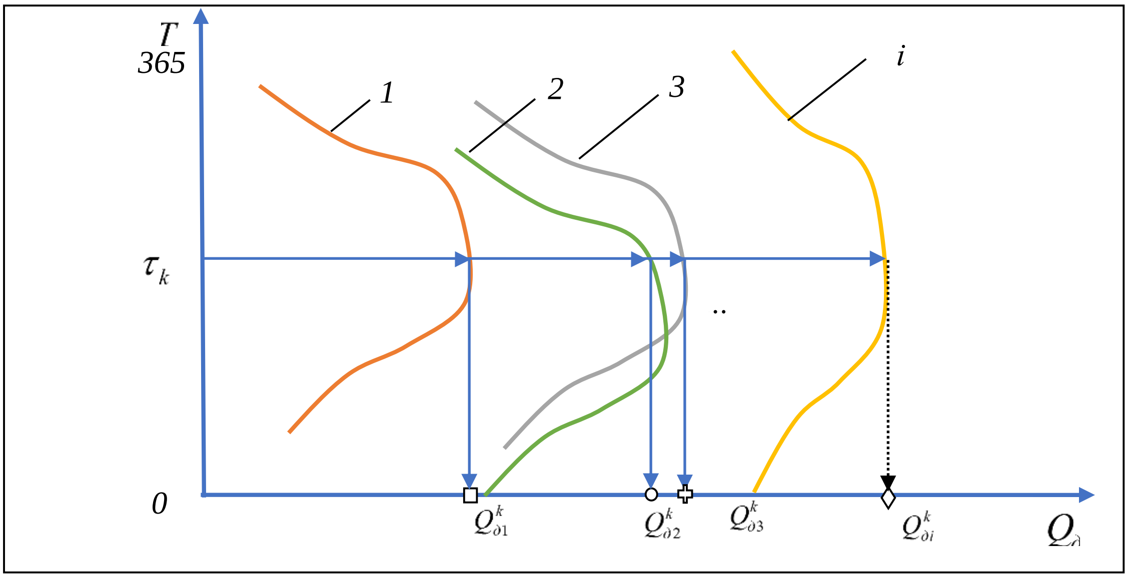

Figure 2: Graphical interpretation of the prediction of the volume $\left(Q_{\partial i}\right)$ of milk harvesting from the i-th farm in the j-th per day: $Q_{\partial 1}^{k}, Q_{\partial 2}^{k}, \ldots, Q_{\partial i}^{k}$ – the daily volume of milk harvesting

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respectively in 1, 2, 3,…, i-th dairy farm producing milk; T - duration of milk harvesting season (calendar year); τ_j – j -th - day of the milk harvesting season

The duration of a tanker truck without a load is determined by the expression:

$$t_{рб_r} = f\left(V_{б_r}, L\right), \tag{2}$$

where $t_{рб_r}$ – duration of movement of the r -th tanker truck without cargo, hour; $V_{б_r}$ – speed of movement of the r -th tanker truck without cargo, km / h; L – the traveled distance, km.

The speed of th r -th tanker truck without cargo is determined by the expression

$$V_{б_r} = f\left(k_{лд}, q_{бr}\right), \tag{3}$$

where $k_{лд}$ – class of roads; $q_{бr}$ – the mass of the r -th tanker truck without cargo, t.

The duration of the territorial movement of a tanker truck is determined by the expression:

$$t_{рз_r} = f\left(V_{з_r}, L\right), \tag{4}$$

where $t_{рз_r}$ – duration of movement of the r -th tanker truck with cargo, hour; $V_{з_r}$ – speed of movement of the r -th tanker truck with cargo, km / h;

$$V_{з_r} = f\left(k_{лд}, q_{з_r}\right), \tag{5}$$

where $q_{з_r}$ – mass of the r -th tanker truck when moving with cargo, t.

The loading time of a tanker truck in PPs is determined by the expression:

$$t_{н_r} = f\left(Q_{\partial\rho}, \psi_{н_r}\right), \tag{6}$$

where $t_{н_r}$ – the duration of loading of the r -th tanker truck in the ρ -th of PPs, h; Q_ρ – volume of milk in ρ -th of PPs, t; $\psi_{н_r}$ – capacity of loading equipment, t / h.

The duration of unloading a tanker truck in the MC is determined by the expression:

$$t_{р_r} = f\left(q_r, \psi_{р_r}\right), \tag{7}$$

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where t_{p_r} – duration of unloading the r-th tanker, h; q_r – cargo of r-th tank truck, t; ψ_{p_r} – performance of unloading equipment, t / h.

The length of service of the tanker of a separate route is determined by the expression:

$$t_{\mu_r} = f\left(L_{c\mu}, \sum_{\rho=1}^{n} Q_{\rho}, \rho_{\mu} \right), \tag{8}$$

where t_{μ_r} – length of stay r-th of the tanker on the μ-th route, hour; $L_{c\mu}$ – total distance traveled by tanker truck on the μ-th route, km; $\sum_{\rho=1}^{n} Q_{\rho}$ – the amount of milk collected from the ρ-th number of PPs per route, t; ρ_{μ} – number of PPs served by one route, units

Step 3. Modelling the work implementation in LMHS *to determine their functional indicators.* The variations in the content and time of the execution of works are a finite set. Preparation works on the delivery of raw milk from PP to MPE can be carried out one, two or three times a day. This is due to the physiological characteristics of cows and the peculiarities of the organization of harvesting works. With regard to the physiological characteristics of cows, in the winter months the cows are milked twice a day, as the duration of the light at a daytime is short. In all other months of the year, milking cows is organized three times a day. This indicates that it is impossible to organize the harvest of milk in a particular day more times than the number of milking cows in this day.

If the milk is harvested three times a day, then each PP should plan trips of tank-vehicles three times as well. If milk is transported twice a day, then there are several options for the content and timing of transportation work: 1) milk that is harvested in the morning and noon is transported at midday, and milk that is harvested in the evening should be transported in the evening; 2) milk that is harvested in the morning, should be transported in the morning, and milk that is harvested at noon and evening is transported in the evening; 3) milk that is harvested in the evening of the previous day may be transported in the morning of the present day, and milk that is harvested at noon may be transported at dinner.

If the transport work is organized once a day, the following options for the content and timing of these works are possible: 1) the milk that is harvested at noon and in the evening of the previous day and in the morning of the current day may be transported in the morning; 2) milk that is harvested in the evening of the previous day and in the morning and the noon of

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the present day is transported at noon; 3) milk that is harvested in the morning, noon and in the evening of the current day may be transported in the evening.

Consequently, there are seven options for the content and time of work among which the most effective should be determined. Determination of an effective variant of work is carried out on the basis of simulation according to the given production conditions of LMHS.

The simulation of the execution of works is carried out in order to determine the indicators of these works for each of the previous substantiated variants of the content and time of these works. These indicators are: 1) technological needs in tank trucks and PP; 2) time costs for individual work and maintenance of individual routes (t_μ); 3) the way passed (L_μ) and the freight traffic (W_μ) on separate routes of milk-raw materials transportation; 4) electricity consumption of refrigeration equipment and water for its washing. To determine these characteristics, we will use the simulation model, which consists of the following blocks: 1) the formation of the database for modeling; 2) simulation of transport work on particular routes; 3) determination of characteristics of works.

Simulation modelling of procurement and transport works was carried out in stages:

A flowchart and algorithm for statistical simulation modelling, as well as software for its implementation on a PC, were developed.

Preliminary modelling was performed and the adequacy of the model was verified for the actual duration of procurement and transport work for the given production conditions.

Computer experiments were performed (simulation modelling of procurement and transport work) for different content and time variants.

The results of simulation modelling were worked out and the dependences of the characteristics of procurement and transport works on their content and time of execution were substantiated.

The simulation model was supposed to - simulate performance of work for various variants of their content and time, as well as the determine indicators of these works. On the basis of mathematical analysis of the results of the simulation, the cost characteristics of the work were determined.

Step 4. Cost evaluation of separate options for the content of the work implementation at LMHS. The cost estimation of each of the variants of the content and the time of execution

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of works is based on the received characteristics of works. For each version of the content and the time of work execution there are current (C_n) and capital (C_κ) expenses determined. Effective content and time of work (Ω) are justified by comparison of C_n and C_κ on their realization. The function of choosing an effective version of the content of the work has the form:

$$\Phi\left(\Omega^{opt}\right) = C_n + C_\kappa \to min\ . \qquad (9)$$

Current and capital expenses for each of the variants of the content of works are determined, respectively, as the sum of current and capital expenses for performing and i- types of works:

$$C_n = \sum_{i=1}^{m} C_{ni}\ ,\ C_\kappa = \sum_{i=1}^{m} C_{\kappa i}\ . \qquad (10)$$

Step 5. Determination of regularities of change of cost indicators and effective variant of the content of work performance in LMHS. Based on the quantified values of the projected cost indicators of the individual options for the content of the work at LMHS, they build their dependence on the day of the harvesting season.

Correlation and regression analysis of these dependencies gives the opportunity to substantiate their equations and correlation coefficients, confirming the likelihood of the obtained patterns of change in the cost indicators of individual options for the content of work in LMHS taking into account the changing production conditions. Effective content is the one option work implementation in LMHS, which ensures minimal consumption of resources to perform daily volume of harvesting and transport operations.

3. MATERIALS AND METHODS

During the researches, the statistic data of "Brody's factory of dry defatted milk" in Brody, Lviv region about the availability of milk farms, from which milk is harvested, amount of milk provision in each of them, availability and territorial location of the PP was used.

With regard to determining the duration of particular works, this stage is carried out on the basis of conducting production experiments for a given project environment. To do this, a time-study of performed works should to be done by using a stopwatch. According to these data, the specific duration of loading and unloading of vehicles that are available at MPE is determined. In addition, fixing the path segments between PP and between PP and MPE using

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the speedometer of vehicles and the duration of their movement by using a stopwatch. Based on these data, the average technical speed of tank vehicles is determined.

The methods of system analysis and synthesis for the formalization of the characteristics of the production conditions of LMHS are used. In order to determine the functional characteristics of LMHS, simulation was performed and computer experiments were performed. In order to determine the length of components of logistic work, the methods of time-study and statistical estimation of the results of experiments were used. For the analysis of the experimental data obtained, the method of graph-analytical analysis was used.

4. RESEARCH RESULTS AND DISCUSSION

Analysis of production conditions LMHS was performed for the conditions of PJSC „BRODY DRIED SKIMMED MILK PLANT", in Brody, Lviv region (Ukraine). On the basis of the method described above, the daily volume of milk intake in MPE from the software was performed during the calendar year. For each of the 27 software of the specified administrative district, obtain data on the volume of milk inflow for processing during separate days of the calendar year (Table 1).

Based on the obtained data, we forecast daily milk flow to MPE from the software during the calendar year. The results of this prediction are presented in Figure. 3.

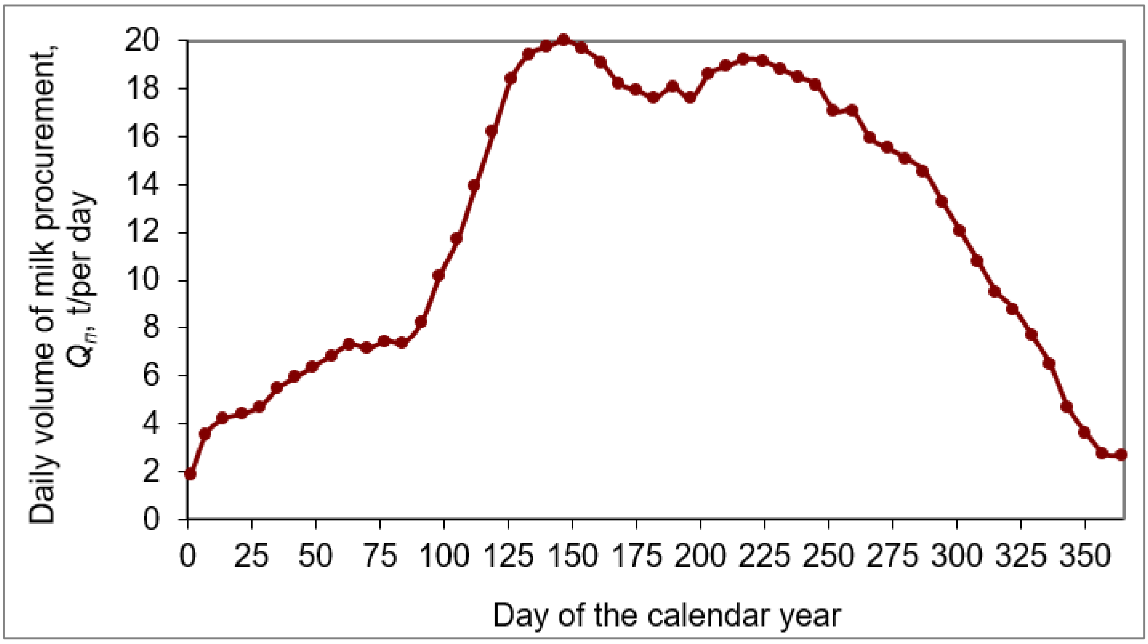

Figure 3: Estimated trends in daily milk supply in MPE from software over the calendar year

Based on the obtained results of forecasting trends in daily milk flow in MPE from software over the calendar year, it is clear that they are variable. It is established that there are

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two periods of milk receipt for processing - intensive (from 119 to 301 days of the calendar year) and non-intensive (from 1 to 118 and from 302 to 365 days of the calendar year).

In order to study the influence of changing production conditions and the content of the works in LMHS on their cost, the imitation of logistic processes was performed on a specially designed computer program. This simulation was carried out in accordance with pre-substantiated variants of the content of logistic works under the variable production conditions of "Brody Factory of Dry Defatted Milk" (Brody, Lviv region), the characteristics of which are given in our paper.

On the basis of simulation of the implementation of logistic processes for each of the variants of the content and the time of execution of works, the following system indicators are determined: total daily cooling time of raw milk in PPs, total daily consumption of water for PP, total daily traffic through tank vehicles, total daily operating time of tank vehicles, total daily freight turnover by tank-vehicles.

It is established that the main indicators of the performance of works in LMHS depend on the variants of the content of their organization and the period of the harvest season. The obtained research results are the basis for determining the cost indicators for the performance of works in LMHS. In particular, on their basis, the choice of an effective version of the content of works in LMHS is carried out. For each of the variants of the content of these works, total daily expenses were determined $\left(C_{nc}\right)$ (Figure 4) for work and total investment $\left(C_{\kappa c}\right)$ (Figure 5), that are needed for these works on different periods of milk harvesting.

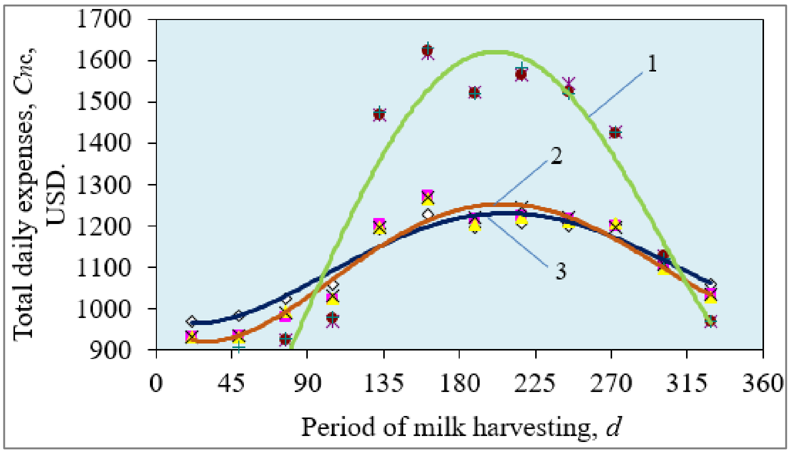

Figure 4: Dependences of total daily operating costs for work in LMHS from the period of milk harvest season, provided that the milk is transported from the PP to the MPE: 1 – three times a day; 2 – twice a day; 3 – once a day.

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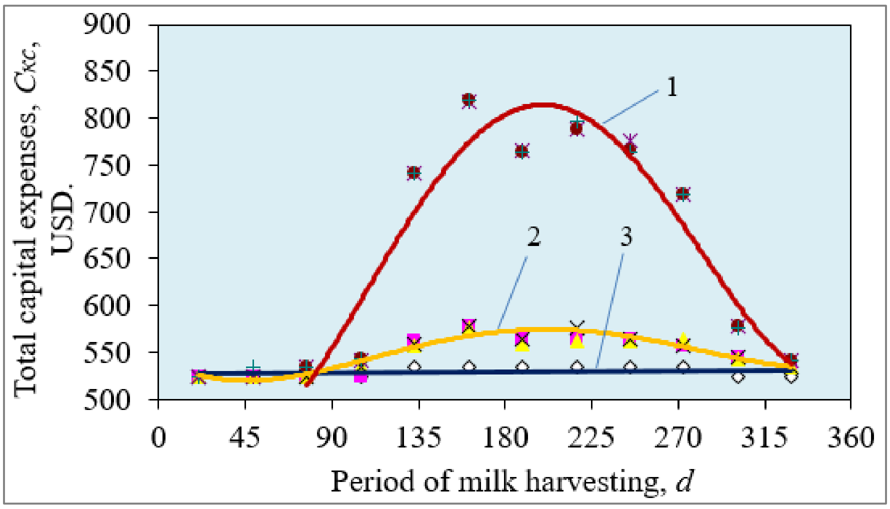

Figure 5: Dependencies of total daily capital expenditures on the execution of works from the time of the season of its harvest, provided that the milk is transported from PP to MPE: 1 – three times a day; 2 – twice daily; 3 – once a day

The obtained correlation dependencies (Figure4) indicate that the current expenses for the work are described by the equations:

- milk is transported from PP to MPE once a day

$$C_{nc1} = 2\times10^{-7}d^4 - 2\times10^{-4}d^3 + 4,41\times10^{-2}d^2 - 1,73d + 982,19,\ r=0,93; \quad (4)$$

- is transported from PP to MPE twice a day

$$C_{nc2} = 4\times10^{-7}d^4 - 3\times10^{-4}d^3 + 7,98\times10^{-2}d^2 - 4,22d + 983,\ r=0,95; \quad (5)$$

- is transported from PP to MPE three times a day

$$C_{nc3} = 8\times10^{-7}d^4 - 7\times10^{-4}d^3 + 13\times10^{-2}d^2 - 0,91d + 438,5,\ r=0,9. \quad (6)$$

The obtained correlation dependencies (Figure 5) indicate that the tendencies of changes in the volume of investments for work are described by equations:

- is transported from PP to MPE once a day

$$C_{\kappa c1} = 6\times10^{-7}d^4 - 5\times10^{-4}d^3 + 0,11d^2 - 7,09\times d + 592,38,\ r=0,91; \quad (7)$$

- is transported from PP to MPE twice a day

$$C_{\kappa c2} = 1\times10^{-7}d^4 - 8\times10^{-5}d^3 + 1,85\times10^{-2}d^2 - 1,23d + 544,42,\ r=0,93. \quad (8)$$

Provided that the milk is transported from the PP to the MPE three times a day, the investment for the work is almost unchanged during the calendar year. Based on the specified cost characteristics of the work, determined specific costs of funds for the performance of these

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works for each of the variants of their content. This made it possible to establish the dependence of the minimum expenses for the work performed (C_{min}), on rational variants of the content of works, from the period of the harvesting season of milk (*d*) (Figure 6).

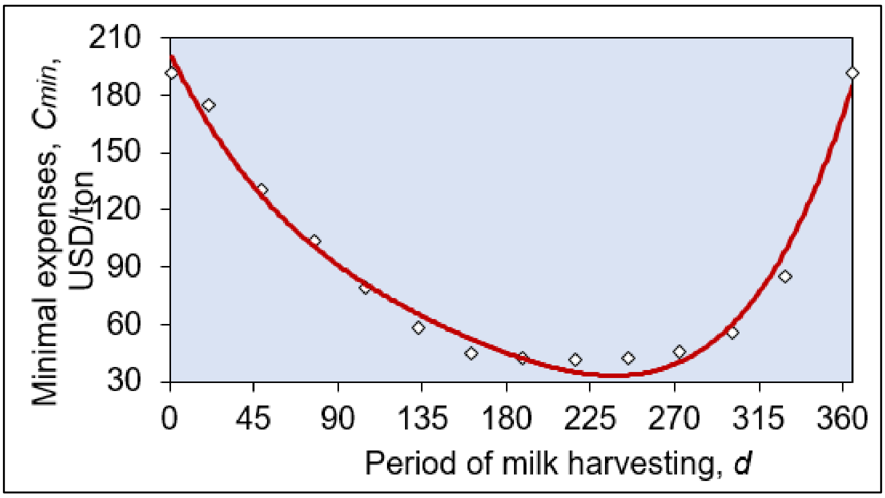

Figure 6: Dependence of minimum specific expenses on works in LMHS from the period of milk harvesting

The obtained correlation dependence (Figure 6) shows that the minimum specific expenses indicated for the work are described by the equation:

$$C_{min} = 1 \times 10^{-8} d^4 - 1 \times 10^5 d^3 + 7,6 \times 10^{-3} d^2 - 2,034d + 214,89 \text{ , } r{=}0,98. \quad (9)$$

The obtained dependence of the minimum specific expenses for the execution of works from the time of the season of its harvest (Figure 6) suggests that the specific costs presented for the performance of works in the LMHS are variable during the year. In addition, the minimum specific costs indicated for these works vary with variations in their content.

Conducted studies of the impact of the content and lead time of work implementation at LMHS on their cost, taking into account the changing production conditions on the basis of simulation modelling of the execution of logistics work, made it possible to determine the quantitative values of the cost indicators of these works for different contents in separate periods of the calendar year.

Existing scientific works are based on the average values of the duration of logistics operations, which does not fully reflect the real conditions. In addition, these works do not take into account the state of the road network between the software and MPE, which makes it impossible to conduct a qualitative and accurate study of the impact of the content and lead time of the works at LMHS on their cost, taking into account the changing production conditions.

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The simulation work performed by us at LMHS has made it possible to eliminate these shortcomings and to more accurately investigate the impact of the content and lead time of work implementation at LMHS on their cost, taking into account the changing production conditions.

The analysis of the individual variants of the content and the time of execution of procurement and transport works in a given LMHS shows that for three times transportation of milk, in comparison with one-time one, the fluctuation of current costs of funds for the execution of works is reduced in 1.05… 1.65 times. At the same time, reducing the number of times milk is transported on a single day leads to an increase in the required load of vehicles and a decrease in the rate of their loading during the calendar year.

It is established that as the volume of logistics work on milk procurement increases, the specific values of the cost performance of these works decrease (specific costs of the work performed at LMHS are given) (Figure 6). This is due to the increase in the truck load factor. At the same time, minimal costs are attributable to the procurement and transport operations during the period of maximum milk production (from 119 to 301 days per calendar year). It is during this period that the maximum load of tankers is observed. The obtained dependency (Figure 6) underlies the substantiation of the effective variant of the content and time of the workpiece transport in the given LMHS.

Consequently, based on the results obtained, it can be argued that for the effective performance of works in LMHS it is necessary to plan their content for each day of the season of milk harvesting. This will provide an opportunity to justify a rational hierarchical structure of work, which will provide the minimum cost of resources in LMHS. The performed research will be useful for managers who perform LMHS planning, as well as during their design. The substantiated regularities of changes in the cost performance indicators will accelerate the implementation of the management decision-making process and increase its quality.

5. CONCLUSION

To solve the problem of coordinating the content of work in logistic milk harvesting systems with changing production conditions, a methodology and simulation model for the implementation of logistic processes was developed. They provide a systematic study of the relevant work due to the consideration of changing production conditions given by LMHS. It has been established that there are seven variants of the content of logistics operations, each of

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which should be considered during the planning of the LMHS operation. The estimating criterion is used to determine the effective content of works in LMHS.

The simulation of the implementation of processes in the LMHS allows the definition of system functional performance indicators, which underlie the forecasting of current costs for the functioning of these systems. It is established that total daily indicators of LMHS functioning depend on the variant of performance of work in them and the period of milk harvest season.

The variable nature of current and capital expenses for performing works in LMHS for different variants of their contents became the basis for a search on the estimating criterion of an effective hierarchical structure of execution of daily procurement and transport work. Based on the conducted research with the simulation model for the conditions of "Brody factory of dry defatted milk", it was substantiated that the biggest influence on the cost of carrying out works in LMHS has the daily amount of milk harvesting, provided that it is transported from the PP to the MPE three times a day.

At the same time, this effect decreases with a decrease in the number of trips to individual PP during the day. The specific expenses for the effective content of works in LMHS are variable during the harvesting season (Figure 3) and are described by the polynomial of the fourth degree. The smallest expenses for the functioning of LMHS occur in the summer months, which are characterized by maximum amount of milk provision.

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